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Healthy Snacks: Chocolate

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Abstract

This study aims to underline the known positive effects of delicious and practical chocolate snacks on health by addressing the historical, chemical and health importance of cocoa and chocolate in detail. The healing journey of cacao and chocolate dates back to the use of cacao for ritual and therapeutic purposes by ancient civilizations such as Olmec, Aztecs to the discovery of America by Columbus and its arrival in Europe, where it became a popular food. Many active ingredients such as phenylethylamine, theobromine, caffeine, compounds in cocoa composition support chocolate's positive effects on health. These components show that chocolate positively affects antioxidant, anti-inflammatory, cardiovascular and neurological health. The product range of functional foods, which we can define as foods enriched with additional nutrients or ingredients that benefit human health, is vast. For example, snack chocolates enriched with probiotics, vitamins or minerals can strengthen the immune system or support bone health. Therefore, it is essential to create significant opportunities to improve the existing physicochemical properties of chocolate by using a variety of functional chocolates and innovative production techniques that will contribute to this diversity, which can increase its benefits to human health. The development of functional chocolates should not only focus on improving health benefits but also on maintaining the sensory properties and taste that consumers are used to. Therefore, the development and dissemination of functional chocolates will be essential in promoting healthy eating habits and preventing chronic diseases. This emphasis on consumer acceptance ensures that the audience feels included in the discussion and the decisions made in the food industry. In conclusion, considering the health importance of cocoa and chocolate, the development of functional chocolates and the application of innovative production techniques have great potential for the future of both consumers and the food industry.

Key Words: *Healthy Snacks, Chocolate, Functional Food*

Sağlıklı Atıştırmalıklar: Çikolata

Özet

Bu çalışmada, kakao ve çikolatanın tarihsel, kimyasal ve sağlık açısından önemini detaylı bir şekilde ele alarak, lezzetli ve pratik çikolatalı atıştırmalıkların sağlık üzerindeki olumlu etkilerinin vurgulanması amaçlanmaktadır. Kakao ve çikolatanın şifa yolculuğu, Olmekler ve Aztekler gibi eski uygarlıkların kakaoyu ritüel ve tedavi amaçlı kullanımlarından, Kolomb'un Amerika'yı keşfiyle Avrupa'ya getirilmesine ve burada popüler bir gıda haline gelmesine kadar uzanmaktadır. Kakaonun bileşiminde yer alan feniletilamin, teobromin, kafein gibi çeşitli aktif bileşenler, çikolatanın sağlık üzerindeki olumlu etkilerine katkı sağlamaktadır. Bu bileşenler, çikolatanın antioksidan, anti-inflamatuar, kardiyovasküler ve nörolojik sağlık üzerinde olumlu etkiler yarattığını ortaya koymaktadır. Fonksiyonel gıdalar, insan sağlığına fayda sağlayan ek besin maddeleri veya bileşenlerle zenginleştirilen gıdalar olarak geniş bir ürün yelpazesine sahiptir. Örneğin, probiyotikler, vitaminler veya mineraller ile zenginleştirilmiş çikolatalı atıştırmalıklar bağışıklık sistemini güçlendirebilir veya kemik sağlığını destekleyebilir. Bu nedenle, çeşitli fonksiyonel çikolataların geliştirilmesi ve bu çeşitliliğe katkıda bulunacak inovatif üretim tekniklerinin kullanılmasıyla çikolatanın mevcut fizikokimyasal özelliklerinin iyileştirilmesi, insan sağlığına olan faydalarını artırma açısından önemli fırsatlar sunmaktadır. Bununla birlikte, bu geliştirme sürecinde, çikolatanın duyusal özelliklerinin korunarak tüketici beklentilerini karşılaması önem arz etmektedir. Fonksiyonel çikolataların geliştirilmesi ve yaygınlaştırılması, sağlıklı beslenme alışkanlıklarının teşvik edilmesi ve kronik hastalıkların önlenmesi açısından da kritik bir adım olacaktır. Tüketicilerin bilinçli seçimler yapmalarını sağlamak, fonksiyonel çikolataların geliştirilmesiyle hem sağlık hem de gıda endüstrisi açısından büyük bir potansiyel taşımaktadır. Sonuç olarak, kakaonun ve çikolatanın sağlık açısından önemi dikkate alındığında, fonksiyonel çikolataların geliştirilmesi ve inovatif üretim tekniklerinin uygulanması, hem tüketicilerin hem de gıda endüstrisinin geleceği için büyük bir potansiyel barındırmaktadır.

Anahtar Kelimeler: *Sağlıklı Atıştırmalıklar, Çikolata, Fonksiyonel Gıda*

Introduction

It is located between 20 degrees north and south latitudes in a region with tropical climate characteristics known as the "cocoa belt" in the world; the origin of cocoa grown in today's Mexican territory dates back to 4000 BC.(Verna, 2013). The Olmec, Maya and Aztec peoples of the region placed cacao at the center of their rituals, associating it with birth, marriage and death themes (Martin, 2006). Believed to have been brought to these lands by the Aztec God Quetzalcoatl, cacao was initially dried and made into a paste with water, then flavored with cinnamon and pepper. This mixture, called Xocolatl, became a medicinal drink preferred by nobles, emperors and soldiers for its stimulating and invigorating effects rather than its flavor (Verna, 2013). Again, in Aztec inscriptions, a source of information about the New World (American continent), there is a source describing the medicinal properties of plants, and there is information that consuming chocolate gives positive results in cases such as loss of appetite, mental fatigue, insufficient breast milk, low sexual appetite(Dillinger et al., 2000). With the discovery of the region by Europeans, the popularity of cocoa and chocolate spread rapidly across continents. In his book 'Food of the Gods,' Head states that the health benefits of chocolate played an essential role in the increase of this popularity and emphasizes the benefits of cocoa such as quenching thirst, calming high fever, nourishing the body and weight gain. Chocolate was regularly included in the food list of the British Navy due to its nutritious properties(Head, 2005). It is known that Brillat-Savarin, one of the famous writers of the period, known in history with the saying "Tell me what you eat and I will tell you who you are," regularly consumed chocolate every morning and recommended it to his close circle. Brillat-Savarin argued that chocolate was good for feminine beauty and regular bowel movements. According to her, digestion is not only a physical process but also an essential factor influencing whether people are cheerful, sad, taciturn or talkative (Baker, 2015).
The examples show that humanity has benefited from the favorable physical and psychological effects of cocoa and chocolate since its first contact with cocoa. Today, it is recognized that these positive effects are due to cocoa's excellent antioxidant properties, its high flavanol content and its known active ingredients, such as caffeine and theobromine (Wind, 2021). Therefore, in addition to cocoa's existing natural nutritional properties, innovative approaches, such as improving the ratio of fat and sugar or using alternative fat sources and sweeteners, will increase the bioavailability of cocoa products and offer significant development opportunities for human health and the food industry.

Chemical Compounds

"Chocolate" from the Spanish Nahuatl language (Dictionary.com, 2023) starts with the fermentation process of cocoa beans, the main component. The beans are dried and roasted, then removed from their shells and separated into cocoa butter and cocoa mass. After the conching process, it is passed through the tempering stage and made suitable for chocolate production(Chocolatemonthclub.com, 2024). In the structure of chocolate, there are more than 500 chemicals, such as phenylethylamine, anandamide, theobromine, caffeine, serotonin, and phenolics, in total. At the same time, there are components such as cocoa butter, sugar, and cocoa-containing milk powder, the most important of which is fat. Chocolate, which has anti-inflammatory and antioxidant properties, is also known for its aphrodisiac effect(Shikha et al., 2019). These chemical components in the structure of chocolate play an essential role in explaining the positive effects of chocolate on human health.

Phenylethylamine

Chocolate contains a compound called phenethylamine, which increases the secretion of the hormone dopamine, which triggers the "feel-good" effect in brain cells (Abbey, 2020). Phenethylamine, also known as a "love compound," is one of the most effective ingredients in chocolate. Although it is present in small amounts in the chocolate's structure, it stimulates the nervous system and triggers the release of endorphins. It also strengthens the activity of dopamine, which is directly related to sexual arousal and desire. Depending on the degree and duration of cocoa roasting, the properties of the components in cocoa biochemistry may vary(Wind, 2021). Therefore, the chemical structure of cocoa and chocolate can vary depending on the production processes, and these changes also determine the effects of chocolate on human health.

Theobromine & Caffeine

Theobromine is an alkaloid also found in coffee and tea. It is chemically similar to caffeine but has a stimulant effect on humans (Criobru.com, 2019). Both components are pharmacologically active chemicals, but theobromine has a slower and longer-lasting effect on the human body than caffeine and does not cause addiction. Caffeine, on the other hand, is faster, stronger and potentially addictive. Thanks to its theobromine content, Cocoa increases focus, provides quality sleep, improves blood flow by dilating blood vessels, and supports deep breathing by relaxing the lungs(Chocante, 2024).

Anandamide

Anandamide is a compound found in cacao that plays a role in essential functions such as pain perception and cravings. It functions as a regulator that keeps the body in homeostasis or balance. The endocannabinoid system is activated by anandamide, which protects against stress-related mental illnesses such as major depression, generalized anxiety and post-traumatic stress disorder. Therefore, it can be said that anandamide is a compound that provides natural happiness and mental balance. Consuming cocoa bean products to address its deficiency can increase levels of this critical neurotransmitter and thus support mental health(Case-Lo, 2020).

Serotenin & Tryptophan

Serotonin is a neurotransmitter that controls and balances your mood and the functions in your brain (Lamoreux, 2023). Serotonin, also known as 5-hydroxytryptamine (5-HT), is involved in human mood and behavior(Trisha A. et al., 2016). Low levels of serotonin in the body are known to have adverse effects on mental health. Therefore, consuming tryptophan-rich foods that trigger an increase in serotonin is crucial(Nerissa and Garry, 2011). Although foods such as cheese, chicken, peanuts, turkey, and peanuts are known to be rich sources of tryptophan, chocolate is also among the foods that attract attention because of its content of this amino acid. Therefore, it is essential to emphasize the potential benefits of chocolate consumption in terms of mental health(Andújar et al., 2012).

Phenolic

Phenolic compounds in cocoa may reduce platelet function, inflammation, and diastolic and systolic arterial pressures by regulating the glycaemic response and changing the lipid profile. When we consider these effects together, they may contribute positively to the risk of cardiovascular mortality. They may also have protective effects against diseases caused or contributed by oxidative stress, such as cancer (Natália et al., 2018). Research in this field shows that phenolic compounds in foods have antioxidant properties (Etaware, 2021). Therefore, chocolate consumption and strengthening the immune system can establish a positive relationship.

General Health Benefits

Cocoa beans contain many phytochemicals that offer a variety of health benefits. These compounds include anticholesterolemic (cholesterol-lowering), antidiabetic (anti-diabetic), hypotensive (blood pressure-lowering), promoting fat burning in the body, increasing intestinal contraction, preventing tumor formation, preventing bronchial asthma, improving proper brain function and preventing memory loss. In addition, it contains amino acids such as glutamine, arginine and leucine, which are beneficial for human health and can facilitate the healing process of cuts and wounds(Great Iruoghene et al.,2021). Therefore, the rich compounds in cocoa beans can positively affect overall health and are recognized as a valuable source of nutrition.

People throughout history have experienced many sources of nutritional problems and healing techniques(Dillinger et al., 2000). These sources also contain information on the relationship between cocoa and chocolate and various diseases. Today, diabetes, cardiovascular diseases, immune system disorders, psychological diseases and joint disorders(Hopkinsmedicine.org, 2024). It is known that chocolate consumption has positive effects on many health problems. Therefore, it can be said that chocolate can be supported by modern science and ancient medicine. Supporting chocolates enriched with functional or bioactive compounds with real studies in this field will contribute positively to human health.

Scientific Research on Functional Chocolates

It is possible to create a general title on the subject by updating the principle of "Let your food be your medicine and your medicine be your food," put forward by Hippocrates thousands of years ago, to "Let functional food be your medicine for health."(Danik and Jaishree, 2015) From another point of view," We can also draw a legal framework on the subject with the definition of "food that has health functions and contains an ingredient officially approved to claim its physiological effects on the human body(Alongi and Anese, 2021) This definition, which was developed to regulate the effects of functional foods on health and their use, provides an essential guideline for evaluating and regulating their use in terms of health. Within the diversity of functional foods, it is necessary to emphasize that snack chocolates should also be considered in this context. Many studies investigate the potential of functional chocolate as an innovative, healthy and tasty option. These studies support the positive effects of chocolate on health and the need to regulate its use. In this context, research to better understand the health benefits and uses of products such as functional chocolate provides essential information that will enable consumers to make informed choices.

In a study on functional spreadable chocolate by Narusorn et al.(2024), It was mentioned that excessive consumption of fats rich in saturated fatty acids (SFA) and trans fatty acids (TFA) used in standard production

plays a role in the development of non-communicable diseases. Therefore, the researchers developed a fatty acid blend containing rice bran oil, camellia oleifera seed oil, perilla seed oil and fish oil as an alternative approach to producing spreadable chocolate. According to the study results, favorable results regarding spreadability and hardness in these fatty acid mixtures prepared in different ratios were obtained. These findings emphasize the importance of using balanced fatty acid profiles in producing spreadable chocolate. More importantly, applying this approach has a potentially positive impact on reducing the consumption of saturated and trans fatty acids, risk factors for non-communicable and long-term slowly progressive chronic diseases, and favoring healthy fats. This suggests that it may contribute to developing a new method for healthy nutrition and preventing chronic diseases.
Merve et al.(2022) The study examined the effect of chocolate on patients with anxiety disorders. The study emphasises that strengthening brain function to improve memory, regulate mood and reduce anxiety and depression is essential to holistic health. The study aimed to create a functional chocolate enriched with bacteria that produce aminobutyric acid (GABA), which has a calming effect on the brain. Lacticaseibacillus rhamnosus, known for its capacity to produce GABA, was microencapsulated with a whey-pullulan complex using a water-in-oil emulsion technique. The results showed that microencapsulated bacteria maintained higher viability compared to free bacteria. Furthermore, adding microencapsulated bacteria did not change chocolate's physical, chemical and sensory properties. This study supports the development of functional foods targeting the "Gut-Brain Axis," suggesting that chocolate may be an effective carrier for GABA-producing bacteria and offer potential therapeutic benefits for anxiety disorder patients.
By Samira et al.(2020) Another study aimed to develop a fruit snack formulation with dried fig powder and sugar-free chocolate coating. According to rheological evaluations, sugar-free chocolate containing 29.3% isomalt was chosen for the coating. Textural analyses showed that coating the core with hydrocolloids reduced the hardness and stickiness of the samples ($p < 0.05$). It was also observed that increasing the concentration of xanthan gum and Persian gum reduced the stickiness of the snacks ($p < 0.05$). Coating the beans with hydrocolloids also resulted in a decrease in the thickness of the outer chocolate shell ($p < 0.05$). The results of the sensory evaluation tests showed that the hydrocolloid-coated samples were the most preferred by the panelists.
In the study conducted by Anna et al.(2022) The development and analytical characterization of a new chocolate product functionalized with vitamin E for use with physical exercise to prevent malnutrition in elderly individuals was discussed. The study investigated the effects of vitamin E-functionalised chocolate with 70% cocoa content, physical exercise, and a protein-rich diet on muscle loss and protein-energy malnutrition (PEM) indicators. Preventing muscle loss was set as the primary goal, and it was suggested that vitamin E and cocoa polyphenols, together with physical activity, may prevent muscle loss in elderly individuals and age-related decline in muscle function. Therefore, it is essential to underline that functional foods can be utilized in improving joint disorders that occur in elderly individuals, and it is necessary to develop product diversity with studies to be carried out in this field.
Another study by Delli et al. (2024) focused on the fact that white chocolate does not contain valuable components such as polyphenols, minerals, vitamins and fibers compared to milk and dark chocolate. For this purpose, a notable blackberry grown in the Amazon forests was added to white chocolate, aiming to improve chocolate's physicochemical properties. As a result of the study, it was revealed that there was an increase in polyphenol and antioxidant activity. Although positive values support these results, it is worth underlining the importance of developing products that will appeal to consumers from a sensory point of view with innovative applications that can be used to add fruit to chocolates, as there is a loss of gloss and color change in the appearance of chocolate.

Conclusion

In conclusion, an in-depth examination of cocoa's health benefits and chemical compositions from its historical journey to the present shows that chocolate is a delicious snack and an essential source of nutrients that contribute to human health. Snack chocolates in the functional foods category, enriched with innovative production techniques, have the potential to protect heart health, strengthen the immune system and have positive effects on neurological health with their antioxidant and anti-inflammatory properties. Chocolates supported with additional ingredients such as probiotics, vitamins and minerals can contribute to the prevention of chronic diseases by promoting healthy eating habits.
Offering health-enriched products without compromising the sensory properties of chocolate increases consumer acceptance and offers innovative and valuable opportunities to the food industry. In this context, developing and disseminating functional chocolates both increase individuals' health awareness and contribute to healthy lifestyles. There is great potential for consumers and the food industry in the future with innovative approaches to further optimize these multifaceted benefits of chocolate.

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